

**PATENT COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**  
(Chapter II of the Patent Cooperation Treaty)  
(PCT Article 36 and Rule 70)

REC'D 24 OCT 2005

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Applicant's or agent's file reference FP19602	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/AU2004/000620	International filing date (day/month/year) 12 May 2004	Priority date (day/month/year) 2 June 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl. <sup>7</sup> F16M 11/00, 13/00, G01N 29/26.		
Applicant ONESTEEL MANUFACTURING PTY LTD et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.	
2. This REPORT consists of a total of 5 sheets, including this cover sheet.	
3. This report is also accompanied by ANNEXES, comprising: a. <input checked="" type="checkbox"/> (sent to the applicant and to the International Bureau) a total of 6 sheets, as follows: <div style="margin-left: 20px;"><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). <input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</div> b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).	
4. This report contains indications relating to the following items: <div style="margin-left: 20px;"><input checked="" type="checkbox"/> Box No. I Basis of the report <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input checked="" type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input checked="" type="checkbox"/> Box No. VII Certain defects in the international application <input type="checkbox"/> Box No. VIII Certain observations on the international application</div>	

Date of submission of the demand 16 December 2004	Date of completion of the report 10 October 2005
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# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/AU2004/000620

## Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This report is based on translations from the original language into the following language which is the language of a translation furnished for the purposes of:
    - ☐ international search (under Rules 12.3 and 23.1 (b))
    - ☐ publication of the international application (under Rule 12.4)
    - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:
  - ☐ the international application as originally filed/furnished
  - ☒ the description:
    - pages 1,3,6 to 18 as originally filed/furnished.
    - pages\* 2,4,5, received by this Authority on 30 August 2005 with the letter of 30 August 2005.
    - pages\* received by this Authority on with the letter of
  - ☒ the claims:
    - pages 21 to 23 as originally filed/furnished
    - pages\* as amended (together with any statement) under Article 19
    - pages\* 19 to 21 received by this Authority on 30 August 2005 with the letter of 30 August 2005.
    - pages\* received by this Authority on with the letter of
  - ☒ the drawings:
    - pages 1 to 14 as originally filed/furnished
    - pages\* received by this Authority on with the letter of
    - pages\* received by this Authority on with the letter of
  - ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
  - ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to the sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
  - ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to the sequence listing (*specify*):

\* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/AU2004/000620

Box No. IV Lack of unity of invention

1. ☐ In response to the invitation to restrict or pay additional fees the applicant has:
- ☐ restricted the claims.
  - ☐ paid additional fees.
  - ☐ paid additional fees under protest.
  - ☐ neither restricted nor paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is:
- ☐ complied with.
  - ☒ not complied with for the following reasons:

Claim 1 is directed to a device for supporting an ultrasonic transducer including a guide surface for the transducer. Claim 16 is directed to the rotational positioning of the ultrasonic transducers about a pipe. Claim 19 is direct to a support device for ultrasonic transducers, which ensure a constant distance between the transducers. Claim 42 is directed to a support frame, which has a carriage for the supporting and moving of the transducers.

4. Consequently, this report has been established in respect of the following parts of the international application:

- ☒ all parts.
- ☐ the parts relating to claims Nos.

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/AU2004/000620

**Box No. V** Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

Novelty (N)	Claims 1 to 49.	YES
	Claims	NO
Inventive step (IS)	Claims 1 to 49.	YES
	Claims	NO
Industrial applicability (IA)	Claims 1 to 49.	YES
	Claims	NO

## 2. Citations and explanations (Rule 70.7)

Novelty (N) and Inventive Step (IS) Claims 1 to 49.

**The invention as defined in the amended independent claims are directed to:**

Claim 1 is directed to a device for supporting an ultrasonic transducer including a guide surface for the transducer. Claim 16 is directed to the rotational positioning of the ultrasonic transducers about a pipe. Claim 19 is directed to a support device for ultrasonic transducers, which ensure a constant distance between the transducers. Claim 42 is directed to a support frame, which has a carriage for the supporting and moving of the transducers.

No individual citation discloses these features, the closest art may be seen in the following documents:

JP 2001194352 A, WO 2001 096808 A, JP 07280776 A, JP09288094 A, JP 2003322643 A, DE 2854374 A, US 4041773 A, US 4213345 A, US 5370006 A, JP 11183453 A, WO 1980 001842 A, FR 2791137 A, SU 1610429 A, SU 1445396 A, EP 412396 A, US 5313837 A.

Industrial Applicability (IA) Claims 1 to 49.

All claims are considered to be industrially applicable.

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY**

International application No.

**PCT/AU2004/000620**

**Box No. VII      Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

As a result of the amendments there will be two pages numbered 21 the first page 21 is as lodged on 30 August 2005 and has the end of claim 20 and claims 21 to 26 on it and the original page 21 as lodged with claims 27 to the first part of claim 30. Note that claims 27 to the first part of claim 30 on the original page 21 is required so that the claims follow through to claim 49 on page 23.

- 2 -

Thus, the transducer can act as both an ultrasonic wave generator and a reflected ultrasonic wave receiver, or a separate receiver can be provided.

Where the reflected ultrasonic wave engages a defect other than a seam weld of acceptable standard, controllers for the transducer can analyse and differentiate this reflected sound wave to determine the existence and the location of a defect.

In the mass production of pipe, particularly where long lengths of pipe are produced, bending, undulations and surface irregularities can be introduced into the pipe due to pipe forming inaccuracies or differential cooling throughout the pipe length, especially in the vicinity of the weld where present. Defects can also be caused by other pipe process steps, including seam welding irregularities, steel making irregularities and burring of pipe ends where the pipe lengths are cut. Such defects can interfere with known ultrasonic testing equipment.

For example, known ultrasonic transducers must be positioned inset from a cut pipe end during feeding of a pipe past the ultrasonic equipment because the ends of the pipe otherwise interfere with and can damage the transducers in use. Also, known transducers can experience difficulties when hindrances to relative transducer movement over the pipe surface are engaged, again leading to either loss of inspection, false readings, damage to the transducer, or all of these.

#### Summary of the Invention

In a first aspect the present invention provides a device for supporting an ultrasonic transducer used for ultrasonic defect testing of pipe, the device comprising:

- a transducer locating portion adapted for positioning adjacent to a pipe to locate the transducer in proximity of the pipe; and
- a guide surface that is fixed against movement in relation to the transducer locating portion, the guide surface being adapted such that, when the device is moved relative to the pipe, it can engage and traverse hindrances in the pipe to such relative device movement.

The term "hindrances" is to be interpreted broadly and includes surface undulations and bevels at the ends of, or along a pipe, external surface defects in the pipe, and bumps, curvatures, bends etc. in the pipe external surface or wall etc., and which may otherwise interfere with the smooth traversing of an ultrasonic transducer across a pipe surface.

In addition, reference to a "relative" movement between the device and pipe indicates that the device can be moved along or around the pipe, or the pipe can be moved with respect to a fixed device, or any combination of these movements. Typically in use the pipe is moved lengthwise past the device, and typically the device is moved around the pipe.

locating portion, into which element the transducer is mountingly located in use. The transducer locator element is typically arranged such that when the transducer is positioned therein, and when the device is moved to its in use position with reference to a pipe, the transducer is disposed in close proximity to the pipe external surface.

5 Preferably the transducer locator element laterally surrounds the transducer and is formed from a material resistant to the propagation of ultrasonic waves therethrough, such that ultrasonic waves are not directed laterally through the device in use. In this regard, the transducer locator element is preferably formed from a ring of polymeric material (eg. a polyurethane) positionable in a body of the transducer locator  
10 portion.

Preferably the transducer locating portion includes a curved in-use underside face for close-facing positioning with the pipe. Typically the curved surface is defined by a radius that is closely matched to a radius defining the external surface of the pipe. Again, this enables for close coupling between the transducer and the pipe.

15 Typically the device is adapted for mounting in an apparatus for moving the device relatively along and/or around and/or towards or away from the pipe in use. In this regard, typically the pipe is advanced into the apparatus (to be advanced past the transducer supporting device). Preferably the apparatus then moves the device towards or away from the pipe, or around the pipe in use. However, other variations are  
20 possible as described hereafter.

Preferably a plurality of ultrasonic transducer supporting devices are mountable in the apparatus.

In a second aspect the present invention provides an apparatus for rotationally positioning one or more ultrasonic transducer supporting devices in proximity of a pipe  
25 to enable ultrasonic defect testing thereof, the apparatus comprising a carriage to which the or each device is mounted, and a means for rotating the or each device around at least part of the pipe's circumference whilst maintaining the or each device in proximity of the pipe; wherein the rotating means is in part incorporated into the carriage to enable the rotation of the or each device about the pipe.

30 Advantageously, the apparatus of the second aspect allows for ultrasonic inspection of pipe to be performed at a number of rotational positions around the pipe. In addition, the apparatus allows a pipe weld seam to be tracked by a transducer during pipe movement therepast (eg. where the seam is non-linear). For example, in a typical ultrasonic inspection of seam welded pipe, one or more ultrasonic transducers are  
35 initially located at or adjacent to a top dead centre of a pipe, with the seam weld also desirably being aligned with top dead centre. However, sometimes during pipe feed the seam weld is misaligned with top dead centre, or becomes misaligned because of pipe

- 5 -

bowing or bending, or seam spiralling. Advantageously, the apparatus of the second aspect allows for ultrasonic inspection of pipe to be performed at different rotational positions that are in alignment with the misaligned seam weld. This allows for seam weld tracking and provides for a more efficient test procedure. Also, mounting of the or each device in a carriage provides for greater rotational positional control as described hereafter.

Typically the pipe is advanced into the apparatus, but the apparatus may also be advanced along the pipe.

Typically one or more pairs of ultrasonic transducer supporting devices are mounted to the carriage and preferably the carriage is configured such that, as a given device pair is moved relative to the pipe (eg. longitudinally or rotationally), an essentially constant distance between each device in the pair is maintained. In this regard, as the devices engage surface irregularities etc. the distance between each device in a given pair essentially remains a constant (although there may be infinitesimal distance changes as one device in the pair raises or lowers in respect to the pipe, relative to the other). Configuring the carriage in this manner has the advantage of maintaining a constant ultrasonic beam path between the devices in the pair, and hence a high integrity of ultrasonic testing is achieved.

In this regard, in a third aspect, the present invention provides an apparatus for positioning one or more ultrasonic transducer supporting device pairs in proximity of a pipe to enable ultrasonic defect testing thereof, the apparatus comprising a carriage to which each device in a pair is pivotally mounted, and means for maintaining an essentially constant distance between each device in a given pair during differential pivoting of the devices in that pair with respect to the carriage in use.

Preferably the carriage includes the rotating means of the second aspect.

Preferably in both the second and third aspects the carriage comprises a first mounting section to which the or each device (or the or each device pair) is pivotally mounted, an intermediate mounting section to which the first mounting section is pivotally mounted, and a second mounting section to which the intermediate mounting section is hinged for pivoting therearound. Whilst the intermediate mounting section can be omitted, it is typically employed to provide the carriage with an extra degree of pivoting movement.

Preferably rotation of the or each device around the pipe from a top dead centre position is effected by moving the second mounting section laterally with respect to the pipe to thereby cause the intermediate mounting section to pivot with respect to the second mounting section, and cause either or both of:  
- the first mounting section to pivot downwardly with respect to the intermediate mounting section;



### CLAIMS

1. A device for supporting an ultrasonic transducer used for ultrasonic defect testing of pipe, the device comprising:
  - 5 a transducer locating portion adapted for positioning adjacent to a pipe to locate the transducer in proximity of the pipe; and
  - a guide surface that is fixed against movement in relation to the transducer locating portion, the guide surface being adapted such that, when the device is moved relative to the pipe, it can engage and traverse hindrances in the pipe to such relative device movement.
- 10 2. A device as claimed in claim 1 wherein the guide surface is located forwardly in the transducer locating portion when the device is moved relatively lengthwise along the pipe.
3. A device as claimed in claim 1 or claim 2 wherein in use the guide surface extends obliquely with respect to a longitudinal axis of the pipe.
- 15 4. A device as claimed in any one of the preceding claims wherein the guide surface is defined:
  - (i) at an end of the transducer locating portion; or
  - (ii) as part of a flange extending away from the transducer locating portion.
- 20 5. A device as claimed in claim 4 wherein in (i) the guide surface is defined as a bevel undercut at an in-use forward end of the device.
6. A device as claimed in claim 4 wherein in (ii) the flange extends away from an in-use forward end of the device and away from the pipe, and the guide surface is defined on a side of the flange facing the pipe.
- 25 7. A device as claimed in any one of the preceding claims wherein the guide surface is planar.
8. A device as claimed in any one of the preceding claims wherein a transducer locator element is disposed within the transducer locating portion, into which element the transducer is mountingly located in use.
- 30 9. A device as claimed in claim 8 wherein the transducer locator element laterally surrounds the transducer and is formed from a material resistant to the propagation of ultrasonic waves therethrough, such that ultrasonic waves are not directed laterally through the device in use.
10. A device as claimed in claim 8 or claim 9 wherein the transducer locator element is formed from a ring of polymeric material positionable in a body of the transducer locating portion.
- 35 11. A device as claimed in any one of the preceding claims wherein the transducer

- 20 -

- locating portion includes a curved in-use underside surface for close-facing positioning with the pipe in use.
12. A device as claimed in claim 11 wherein the curved surface is defined by a radius that is closely matched to a radius defining the external surface of the pipe.
- 5 13. A device as claimed in any one of the preceding claims that is adapted for mounting in an apparatus for moving the device relatively along and/or around and/or towards/away from the pipe in use.
14. A device as claimed in claim 13 wherein a plurality of the ultrasonic transducer supporting devices are mountable in the apparatus.
- 10 15. A device for supporting an ultrasonic transducer, the device being substantially as herein described with reference to the accompanying drawings.
16. An apparatus for rotationally positioning one or more ultrasonic transducer supporting devices in proximity of a pipe to enable ultrasonic defect testing thereof, the apparatus comprising a carriage to which the or each device is  
15 mounted, and a means for rotating the or each device around at least part of the pipe's circumference whilst maintaining the or each device in proximity of the pipe, wherein the rotating means is in part incorporated into the carriage to enable the rotation of the or each device about the pipe.
17. Apparatus as claimed in claim 16 wherein one or more pairs of ultrasonic  
20 transducer supporting devices are mounted to the carriage, and wherein the carriage is configured such that, as a given device pair is moved relative to the pipe, an essentially constant distance between each device in the pair is maintained.
18. Apparatus as claimed in claim 17 wherein the distance is maintained between each  
25 device by connecting each device via a respective arm to a portion of the carriage, and by providing an internally threaded sleeve at the arm end that receives therethrough and that is mounted for rotational movement thereon and therealong of an externally threaded shank, the shank in turn being mounted to the carriage portion.
- 30 19. An apparatus for positioning one or more ultrasonic transducer supporting device pairs in proximity of a pipe to enable ultrasonic defect testing thereof, the apparatus comprising a carriage to which each device in a pair is pivotally mounted, and means for maintaining an essentially constant distance between each  
35 device in a given pair during differential pivoting of the device in that pair with respect to the carriage in use.
20. Apparatus as claimed in claim 19 wherein the carriage includes the rotating means as claimed in claim 16, and wherein the means for maintaining the distance is as defined in claim 18.
- 40 21. Apparatus as claimed in any one of claims 17, 18 or 20 wherein the carriage comprises a first mounting section to which the or each device is pivotally mounted, an intermediate mounting section to which the first mounting section is pivotally mounted, and a second mounting section to which the intermediate mounting section is hinged for pivoting therearound.

- 21 -

22. Apparatus as claimed in claim 21 when dependant on claim 18 wherein the one or more ultrasonic transducer supporting device pairs are each pivotally mounted to the first mounting section via the carriage portion, the or each carriage portion comprising respective section for mounting a corresponding shank portion, the  
5        respective carriage section orienting an elongate axis of the shank portion such that it is parallel to a tangent line to the pipe surface adjacent to the respective transducer supporting device, with this arrangement contributing to the maintenance of the essentially constant distance between the devices in a given pair.
- 10    23. Apparatus as claimed in claim 21 or 22 wherein the rotation of the or each device around the pipe from a top dead centre position is effected by moving the second mounting section laterally with respect to the pipe to thereby cause the intermediate mounting section to pivot with respect to the second mounting section, and cause either or both of:
- 15        - the first mounting section to pivot downwardly with respect to the intermediate mounting section;  
       - the or each device to pivot downwardly with respect to the first mounting section;  
       thus moving the device(s) down and around the pipe whilst maintaining device  
20        proximity to an external surface of the pipe.
24. Apparatus as claimed in claim 23 wherein guide rollers are provided at opposite ends of the first mounting section for riding along the pipe external surface during relative movement between the pipe and the or each device, with the or each device being located on the first mounting section between the guide rollers.
- 25    25. Apparatus as claimed in claim 24 wherein, when the second mounting section is moved laterally with respect to the pipe, the guide rollers engage the pipe and cause the intermediate mounting section to pivot with respect to the second mounting section.
26. Apparatus as claimed in claim 24 or 25 wherein each guide roller is a V roller, having a V-shaped circumferential groove extending therearound between its  
30        ends, and into which groove the pipe is received in use.
27. Apparatus as claimed in any one of claims 24 to 26 wherein each roller is formed from an elastomeric material to facilitate rolling and lateral engagement with the pipe external surface.
- 35    28. Apparatus as claimed in any one of claims 21 to 27 wherein the or each device is pivotally mounted to the first mounting section via a respective connecting arm behind which the device trails during relative movement between the device and the pipe.
29. Apparatus as claimed in any one of claims 21 to 28 wherein the first mounting  
40        section is pivotally mounted to the intermediate mounting section via respective coupling arm pairs behind which the first mounting section trails during relative movement between the device and the pipe.
30. Apparatus as claimed in any one of claims 21 to 29 wherein the second mounting section is mounted to a framework that supports means for laterally moving the